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NO DRAWINGS

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(54) DOCTOR BLADE ROLL ASSEMBLY

(71) We, BELOIT CORPORATION of Beloit, Wisconsin 53511, United States of America, County of Rock and State of Wisconsin, United States of America, a corporation organised and existing under the laws of the State of Wisconsin, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to rolls for roll/doctor blade assemblies. In a number of industrial applications, it is necessary to remove travelling material from a roll carrying the material by means of a doctor blade. The use of a doctor blade in direct contact with a roll, wherein the blade removes material from the roll, is an integral part of many processes which could not be performed without such a roll-doctor blade relationship.

One particular industry wherein doctor blades are employed in conjunction with a roll is the paper industry wherein travelling belts of paper and paper pulp are conveyed by a series of rolls during the paper-making process. It is necessary to remove the paper from a particular roll to transfer the paper to a further part of the process. More often, the doctor blade is used to clean the roll after material has been removed therefrom since it can readily be appreciated that fine particles of paper or paper pulp or contaminants which remain on the roll during its contact with the travelling belt would cause imperfections in the belt, thereby lessening the value of the product. Due to the high speeds involved in the paper-making process, such as where the paper itself is travelling in excess of 3,000 feet per minute, it is absolutely imperative that the rolls be maintained in a clean condition.

Due to the particular nature of the doctor blade itself, the doctor blade is almost universally manufactured from some metal. Prior art rolls which have been employed in relationship with the doctor blade have also been manufactured from metal, thereby giving rise to a metal to metal contact between the roll and the doctor blade. This metal to metal contact is undesirable for several reasons, in that heat generation has a material effect upon the paper and because the wear of the roll or the doctor blade is excessive. The high cost of metals which are resistant to the problems of overheating and/or unacceptable wear is prohibitive, and the alternative use of less expensive metals gives rise to an increase in operation costs, repairs and replacement.

Substitutions of other materials for the outer surface of the roll has not yet found success. The roll must be able to withstand high nip pressures and/or high speeds without deterioration, such as wherein a roll may be employed in a press section or the like. Moreover, these rolls must be able to withstand continuous contact with a doctor blade without adversely affecting the surface of the roll or the doctor blade itself.

Fibre glass and other woven fabrics have been proposed for use as roll coverings in conjunction with doctor blades, but it has been found that where these materials have been tried, excessive wear on the doctor blade has occurred. Possibly due to the pattern of distribution of the fibres, with the regular orientation, the fibres apparently cause significant wear on the doctor blades used in association therewith. Moreover, it is believed that the fibres themselves tend to resist relative movement with the doctor blade due to the woven structure.

The present invention obviates the difficulties incurred in applying rolls in operative relationships as assemblies with doctor blades. Substantially less wear of the blade is achieved while the roll itself remains clean as desired without exessive heating of

the roll or roll wear. Basically, the invention comprises the use of a roll covering for use with rolls in operative relationship with doctor blades. The roll covering consists of a nonwoven mat wrapping the roll bonded with a thermosetting resin. It is preferred that the nonwoven mat itself has a tensile strength of at least 5 pounds per inch.

Preferred materials for use as the nonwoven mat in the present invention are mats which are prepared from the following fibres: nylon, acrylic fibres, i.e., manufactured fibres in which the fibre-forming substance is any long chain synthetic polymer composed of at least 85% by weight of acrylonitrile units — $CH_2CH(CN)$ —. Other such materials include polyester fibres, cellulose acetate fibres, asbestos fibres, cotton fibres, sisal fibres, polyamide fibres, rayon fibres, polyolefin fibres, and the various other acetate fibres. All of these fibres are of a class which can be formed into a nonwoven mat of reasonable dimensional stability and strength.

The thermosetting resins employed to to bond the nonwoven mat which has been wrapped on the roll to form a covering are broadly defined as condensation polymers or copolymers formed through the reaction of the functional groups of the monomeric organic compounds with the possible elimination of water or similar by-products. A number of classes of thermosetting resins useful in the present invention are outlined as follows: Phenolics are resins produced by the reaction of phenols with aldehydes, such as phenol and formaldehyde. Urea and melamine resines are formed by the reaction between the hydrogen of the amine groups of urea or melamine and the hydroxyl of the hydrated formaldehyde.

Two classes which are closely related are the alkyds and polyester resins which are basically modified and unmodified polyester resins. The polyester resins are formed by the reaction of a polybasic acid such as adipic, or sebacic, acids with a polyfunctional component such as glycols or glycerol. The modified or alkyd resins employ a fatty glyceride or fatty acid such as linoleic acid.

Yet another class of thermosetting resins which may be employed as bonding agents in the present invention, and which constitute the preferred class of thermosetting resins, are the epoxides. Epoxides contain epoxy groups which are cured with either diamines or dibasic anhydrides. Epoxides are prepared from, for example, the reaction of phenol and acetone to produced Bisphenol-A, which is in turn reacted with epichlorohydrin to yield an epoxy intermediate. Diamine or dibasic anhydrides are used to cure the epoxide to produce a thermosetting resin.

Another class of thermosetting resins which is of use in the present invention is the acrylic resins. These acrylic resins are acrylate or methacrylate ester polymers, although they may include acrylonitrile and chloroacrylate polymers. These polymers are polymerised alone with comonomers to give the resulting resin.

Preparation of the roll with the covering of this invention is a relatively straightforward process and may be done in a conventional manner. In an example, a non woven mat of acrylic fibres (as defined above) is wrapped about the roll to be covered. Prior to the roll being wrapped with the nonwoven mat, the thermosetting resin is applied to saturate the mat, after which the resin is allowed to cure to final hardness.

In another specific example, a non woven mat of acrylic fibres was applied to a roll in 5" widths by wrapping the roll in one pass using a small lead. At this point, a solution of epoxy resin and curing agent was applied to the mat and allowed to cure. The resulting bonded mat wos about 0.050 inches thick and had a tensile strength in excess of 20 pounds per inch. Samples of the mat were subjected to tension and it was found that the elongation ranged from about 12 to about 15%. Under tension, the bonded mat reduced in width but not in thickness.

In a preferred embodiment of the present invention, the roll covering which has been applied to the roll for use in combination with the doctor blade is machined to provide a smooth uniform surface for use in the particular process for which the roll is intended. It is possible to machine the covering to a smooth surface with simple tooling and it is not necessary in most cases to use a grinder or other more elaborate processes.

To demonstrate the effectiveness of the present invention several experiments were run to deliberately measure the wear effect on a doctor blade. In the first experiment, a nonwoven mat of acrylic fibres was applied to a roll as a covering and was bonded with an epoxy resin. The roll was placed in operative relationship with a conventional doctor blade and was rotated at a linear speed of 2700 feet per minute for 40 days. At the end of the 40 days of operation, the roll and the doctor blade were inspected. It was found that the roll had actually increased in diameter by 0.001 inches, presumably due to slight swelling from the water shower employed as a coolant. Blade wear was also examined and it was discovered that the blade had been worn down by 0.014 inches, which represents a degree of wear which is far less than had been previously found.

In the second experiment, a woven fibreglass mat was wrapped in a similar manner about a roll and bonded to the roll with the

same epoxy resin employed in the first experiment. Using similar apparatus and an identical doctor blade, the roll was caused to turn in operative relationship with the doctor blade at a linear speed of 2700 feet per minute for 24 days. At the end of the 24 day period, the roll was inspected and found to have decreased in diameter by 0.001 inches, a negligible amount. However, inspection of the wear of the doctor blade showed that the doctor had worn down by 0.063 inches, over four times as much as in the first experiment in only slightly greater than half the period of time. It is believed that the wear would have been even greater, had there been any adjustment in the operating pressure between the roll and the blade. It was found that the roll employed in the second experiment was more difficult to clean, due to the substantially greater wear in the doctor blade, which would have resulted in a necessity for adjustment had the roll been employed in a commercial process.

As can be seen, it is now possible to operate a roll in contact with a doctor blade for substantial periods of time without materially effecting the doctor blade or the roll, provided that the roll covering consists of a nonwoven mat wrapping said roll and bonded with a thermosetting resin. It is possible to employ these rolls in combination with doctor blades in a wide variety of industries, including but not being limited to the paper industry, the textile industry, the food production industry and the like.

Broadly the invention is directed to the combination of a roll, and a doctor blade in operative selection therewith, the roll comprising an outer surfac layer of a non-woven mat wrapping the roll bonded with a thermosetting resin.

WHAT WE CLAIM IS:—

1. In combination, a roll and a doctor blade in operative relationship therewith, said roll having a covering consisting of a non-woven mat wrapping said roll bonded with a thermosetting resin.

2. The combination as claimed in claim 1 wherein the mat has a tensile strength before bonding of at least five pounds per inch.

3. The combination as claimed in claim 1 or 2 wherein the non-woven mat comprises a non-woven mat of acrylic fibres, nylon fibres, polyester fibres, cellulose acetate fibres, asbestos fibres, cotton fibres, sisal fibres, polyamide fibres, rayon fibres, and polyolefin fibres.

4. The combination as claimed in any preceding claim, wherein the thermosetting resin is an acrylic or epoxy resin.

5. The combination as claimed in any preceding claim wherein the covering has been machined after bonding of the mat with the resin to provide a smooth surface thereon.

6. A roll-doctor blade assembly as claimed in claim 1 substantially as herein described.

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